1. A method of converting one or more reactants to a desired end product, comprising:

introducing a reactant stream at one end of an axial reactor;

heating the reactant stream as the reactant stream flows axially through an injection line having a reduced diameter with respect to the axial reactor to produce turbulent flow and thereby thoroughly mix the reactant stream with a heating gas; and

passing the thoroughly mixed reactant stream axially through a reaction zone of the axial reactor, the reaction zone maintained at a substantially uniform temperature over the length of the reaction zone, wherein the axial reactor has a length and a temperature and is operated under conditions sufficient to effect heating of the reactant stream to a selected reaction temperature at which a desired product stream is produced at a location adjacent the outlet end of the axial reactor.

2. The method of claim 1, wherein the reactant stream comprises methane and the desired end product comprises acetylene.

3. The method of claim 1, wherein the reactant stream comprises methane or carbon monoxide and the desired end product comprises hydrogen.

4. The method of claim 1, wherein the reactant stream comprises a titanium compound and the desired end product comprises titanium or titanium dioxide.

5. The method of claim 1, wherein the reaction zone is maintained at a substantially uniform temperature by a hot wall surrounding the reaction zone, with the hot wall surrounded by an insulating layer.

6. The method of claim 5, wherein the insulating layer comprises a material selected from the group consisting of carbon, boron nitride, zirconia, silicon carbide, and combinations thereof.

7. The method of claim 5, wherein the temperature of the reaction zone is maintained between about 1500°C and about 2500°C.

8. A method for thermal conversion of one or more reactants in a thermodynamically stable high temperature gaseous stream to a desired end product in the form of a gas or ultrafine solid particles, the method comprising the steps of:

introducing a stream of plasma arc gas between electrodes of a plasma torch including at least one pair of electrodes positioned adjacent to an inlet end of an axial reactor chamber, the stream of plasma arc gas being introduced at a selected plasma gas flow while the electrodes are subjected to a selected plasma input

power level to produce a plasma in a restricted diameter injection line that extends into the reactor chamber and toward an outlet end of the reactor chamber;

thoroughly mixing an incoming reactant stream into the plasma by injecting at least one reactant into the injection line to produce the thorough mixing prior to introduction into the reactor chamber, the reactor chamber maintained at a substantially uniform temperature over the flow field for the reactions to reach equilibrium;

cooling the gaseous stream exiting a nozzle at the outlet end of the reactor chamber by reducing the velocity of the gaseous stream while removing heat energy at a rate sufficient to prevent increases in its kinetic temperature; and

separating desired end products from gases remaining in the cooled gaseous stream.

9. The method of claim 8, wherein the one or more reactants comprises methane and the desired end product comprises acetylene.

10. The method of claim 8, wherein the one or more reactants comprises methane or carbon monoxide and the desired end product comprises hydrogen.

11. The method of claim 8, wherein the one or more reactants comprises a titanium compound and the desired end product comprises titanium or titanium dioxide.

12. The method of claim 8, wherein the reactor chamber comprises a reaction zone section, which is maintained at a substantially uniform temperature by a hot wall surrounding the reaction zone, with the hot wall surrounded by an insulating layer.

13. The method of claim 12, wherein the insulating layer is surrounded by a cooling layer to prevent degradation of the reaction chamber.

14. The method of claim 12, wherein the insulating layer comprises a carbon layer and the cooling layer comprises a layer of cool water.

15. The method of claim 12, wherein the temperature of the reaction zone of the reactor chamber is maintained between about 1500°C and about 2500°C.

16. The method of claim 12, wherein the temperature of the reaction zone is maintained between about 1700°C and 2000°.

17. The method of claim 12, wherein the reactants which have passed through the reaction zone are then cooled by directing the product stream thus produced through a coaxial convergent-divergent nozzle positioned in the outlet end of the reactor chamber to rapidly cool the product stream

18. The method of claim 12, wherein the injection line is maintained at a diameter to produce turbulent flow and thorough mixing of the incoming plasma gases and the reactant stream and wherein the injection line is of a smaller diameter than the diameter of the reaction zone of the reactor chamber.

19. An apparatus for carrying out the method of claim 8.

20. An apparatus for thermal conversion of one or more reactants in a thermodynamically stable high temperature gaseous stream to a desired end product in the form of a gas or ultrafine solid particles, the apparatus comprising:

means for introducing a reactant stream at or upstream from an inlet end of an axial reactor;

means for producing a hot gaseous stream upstream from the inlet end of the axial reactor, wherein the stream is flowing axially toward an outlet end of the axial reactor;

means for passing the reactant stream and the hot gaseous stream through an injection line having a reduced diameter to produce turbulent flow and thereby thoroughly mix the reactant stream with the hot gaseous stream; and

means for minimizing radial temperature gradients within the axial reactor;

wherein the axial reactor is operated under conditions sufficient to effect heating of the reactant stream to a selected reaction temperature at which a

desired end product is produced at a location adjacent the outlet end of the axial reactor.